



September 18, 1992

In Reply  
Refer To: HW-113

Robert L. Geddes  
Senior Environmental Engineer  
Monsanto Chemical Company  
P.O. Box 816  
Soda Springs, ID 83276

Subject: Phase II Remedial Investigation/Feasibility Study Work  
Plan for the Soda Springs Elemental Phosphorus Plant

Dear Mr. Geddes:

EPA's review of Monsanto's proposed Phase II Remedial Investigation/Feasibility Study Work Plan for the Monsanto Soda Springs Plant dated July 22, 1992, is complete except for the air pathway portions and any reevaluation which may be necessary after review of the data from the May 1992 groundwater sampling event. EPA will complete its review and provide additional comments once the May 1992 sampling results and responses to the enclosed comments and questions are provided to EPA.

The Work Plan as written does an adequate job of summarizing existing data. As discussed in the enclosed comments, however, in some areas EPA's analysis of the data and tentative conclusions about their significance differs from Monsanto's, and in some areas EPA sees the need for additional data to complete site characterization. The Work Plan also lacked specificity as to how the data to be collected will support risk assessment and feasibility study needs and allow for refinement of the conceptual site model with respect to pathways and exposures.

To help you better understand the comments and EPA's risk assessment data needs, enclosed for your information is the latest Draft Preliminary Identification of Contaminants of Concern for the Monsanto site prepared for EPA by SAIC (dated 9/3/92). Please note that the screening analysis presented in that document is considered preliminary and is based only on the available data collected so far, and that further screening for potential contaminants of concern and a more thorough analysis of exposure will be necessary as more data are received.

In order to allow field work to proceed in a timely manner, by this letter EPA is approving Task 4 (the Soils Investigation) of the Work Plan subject to Monsanto's satisfactorily addressing

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the enclosed comments which relate to that task (particularly comments #6, 7, 11, 19 and 27) in writing at least 2 weeks prior to the planned sampling dates.

Monsanto should provide EPA with a response to the enclosed comments and questions and a discussion of how they will be addressed in the Work Plan within 14 days, as specified in the Administrative Order on Consent. As part of that response, Monsanto should also discuss how the May, 1992 groundwater data compares with previous results and interpretations, what changes Monsanto proposes making to the Hydrogeological Investigation (Task 5), and how they should be addressed in the Work Plan.

If you have any questions about this letter, the attached comments, or the enclosure please do not hesitate to call me at (206) 553-2100. I am also available to meet and discuss either the comments or your responses if such a meeting would be helpful to you.

Sincerely,

  
Timothy H. Brincefield  
Superfund Project Manager

Enclosures

cc: Charles Ordine, EPA ORC    *w/o attachments*  
Christine Psyk, EPA Superfund  
Lorraine Edmond, EPA ESD  
Don Matheny, EPA ESD  
Gordon Brown, IDHW  
Mike Thomas, IDHW  
Jim Eldridge, SAIC  
David Banton, Golder Associates

Monsanto Phase II RI/FS Work Plan

GENERAL COMMENTS

The Work Plan should be specific as to how the data to be collected will support risk assessment and feasibility study needs and allow for refinement of the conceptual site model with respect to pathways and exposures.

The Work Plan should identify the differences between and evaluate the comparability of the inputs, assumptions and methods proposed for Phase II air modeling with those used in Phase I. This may also need to be addressed in more detail later if results from both modelling efforts are to be used in the RI.

The Standard Operating Procedures contained in the Quality Assurance Project Plan are somewhat vague and certainly not site specific, but are probably acceptable for the proposed work considering Golder Associates' previous experience with the site.

Isopleth maps showing the data for the groundwater plumes of constituents of concern should be provided to facilitate interpretation of the data.

SPECIFIC COMMENTS

1. Page 9, Section 2.2.1. It is stated that the phosphy and seal water ponds are bentonite lined; however, on page 10 in the first full paragraph it is claimed that they are lined with synthetic membranes. Clarification and consistency with the Preliminary Site Characterization Summary Report (PSCSR) should be provided.
2. Page 10, Section 2.2.1. It is stated that the ferrophosphorus slag, baghouse dust, and underflow solids ponds were not sampled for chemical or physical analyses during the Phase I RI. Certain baghouse dusts and underflow solids were sampled. Please clarify.
3. Page 16, Section 2.2.2.3. The second sentence of the 5th paragraph should be clarified to read "....accounting for about 99% of the total cadmium emissions."

Based on Table 5-11 in the PSCSR, the first sentence of the last paragraph should be corrected to state that the various baghouses are estimated to contribute 3% or less of the total trace metal  $PM_{10}$  emissions from the facility.

4. Page 17, Section 2.2.2.3. Even though fugitive emissions from baghouse dusts stockpiled on the northern portion of the site contribute a relatively small portion of the total facility emissions (estimated from Phase I modeling), these sources appear to contribute a sizeable portion of the predicted  $PM_{10}$  and TSP concentrations at various receptor locations.

Tables 5-14 through 5-21 in the PSCSR provide predicted  $PM_{10}$  and TSP concentrations at several discrete receptors. When property line receptors (#33 - #36) are evaluated with respect to those sources that contribute the greatest percentages to the total  $PM_{10}$  and TSP concentrations, it is generally found that emissions from wind erosion, roads, and material handling contribute significantly. For example, based on Table 5-15 in the PSCSR, the north property line is predicted to receive approximately 48 percent of the total  $PM_{10}$  concentrations from wind erosion, roads, and material handling. In comparison, only 4 percent of the total  $PM_{10}$  is attributable to the permitted sources.

Similarly, at the high school (receptor #7), approximately 22 percent of the total  $PM_{10}$  concentrations are attributable to wind erosion, roads, and material handling; whereas, 9 percent is attributable from the permitted sources.

It is critical for Monsanto to include an evaluation of the potential impact that specific source emissions have on various receptor locations. An evaluation of other contaminant migration mechanisms, such as deposition and saltation should also be explored to determine those sources that contribute to elevated levels of constituents in air and soils off site.

The EPA 1982 reference (EPA 520/6-82-021) cited in the last paragraph pertains to the Monsanto Columbia, Tennessee Plant rather than the Soda Springs facility.

5. Page 18, Section 2.2.2.3. To avoid confusion with air emissions of radionuclides from radionuclide emissions (radioactivity), it is suggested that "air emissions of radionuclides" be used in lieu of "radionuclide emissions".

It should be noted that the risk assessment discussed in the EPA (1989b) reference was based only upon emissions from the calciner stacks and no other source. Data in the PSCSR indicates that emissions from the stacks partially contribute to air quality at the various receptor locations, as mentioned in the previous comment. Thus, the first sentence in the third paragraph should be clarified to read

"....one of the largest sources of air emissions of radionuclides at the facility is the kiln operation..."

In addition, risks from radon were not specifically analyzed with respect to the Monsanto, Soda Springs facility in the 1989b reference; instead, radon risks were assumed from much older documents. While it may be true that radon-222 (with a half-life of 3.8 days) would contribute 1% or less to the total individual risk over a lifetime; once inhaled, its decay progeny (Pb-210 and Po-210) can then contribute to the longer exposure period. Based on limited historical radon sampling at phosphorus plants, there is indication that large quantities are released and the inhalation exposure potential may be high; thus, indirectly contributing to total risk. In addition, most of the constituents of concern in off-site soils and on-site source piles are part of the uranium decay series. There is a data gap for radon in this series as a potential contaminant of concern. Therefore, Monsanto should include radon-222 in the air modeling assessment from all potential source areas and evaluate the need for radon air monitors.

The fourth paragraph should include underflow solids, slurry, and baghouse dusts as sources of radionuclides (See Table 4-1 in the PSCSR). The contribution of emissions from these sources to various receptor locations (both on and off-site) should also be evaluated in Phase II. Since most of the COCs are also gamma emitters, Monsanto should also consider a gamma survey program for those areas where COCs are found. Such a survey would assist in quantifying radiation exposure to receptor areas.

6. Page 20, Section 2.2.4. Based on a preliminary risk-based screening conducted by EPA, the constituents of potential interest in Group-A soils should also include aluminum, chromium (VI), lead-210, and vanadium. For Group-B soils, aluminum, cadmium, lead-210, manganese, thorium-228, and vanadium should be included. In addition, silver and zinc are of potential concern based on ecological risk screening levels. These constituents should therefore be evaluated in the air modelling assessment for Phase II.
7. Page 20, Section 2.2.4. The last paragraph on Page 20 states that it is not conclusive that plant activities are solely responsible for the elevated constituents. While this may be true, it is the responsibility of Monsanto to determine the nature and extent of any contaminant releases from the Monsanto facility, including as necessary sampling in areas which could potentially also include constituents from other sources.

8. Page 21, Section 2.2.4. For screening purposes, EPA does not totally rely on the UTL approach with sample sizes from 3 to 6 that also have variable standard deviations. Other information is useful to help determine the range to focus on.

A reference should be provided for the manganese screening value of 14,600 mg/kg. The EPA risk-based screening level (2700 mg/kg) indicates that manganese be retained. In addition, manganese is of concern for ecological risk and is considered a constituent of concern in the Fresh Water Shallow Aquifer.

9. Page 22, Section 2.2.5.5. The statement that several constituents in ground water are only of potential interest because of welfare or aesthetic reasons is erroneous and misleading. These constituents will be evaluated in the risk assessment.
10. Page 23, Section 2.2.5.2. Based on EPA's risk screening process the constituents of concern in the shallow ground water should include aluminum, beryllium, chromium, fluoride, iron, manganese, molybdenum, selenium, sulfate, vanadium and radon-222. Likewise, constituents of interest in the Chesterfield Range Aquifer should include aluminum, arsenic, chromium VI, iron, manganese, molybdenum, sulfate ion, and radon-222.
11. Page 25, Section 2.2.5.4. The Work Plan's discussion on the temporal changes of constituent concentrations in UBZ-2 cannot be entirely supported with data presented in the PSCSR. EPA has not yet had the opportunity to evaluate the data collected during the May 1992, sampling event. Plotting of the May 1992, analytical data is needed to confirm the assertion that concentrations are currently decreasing. Due to the four year gap in data collection, it is not possible to evaluate with much certainty the claim that concentrations of many constituents (except fluoride) are decreasing with time in UBZ-2.

Similarly, the statement about cadmium decreasing with time in UBZ-1 is not supported by the temporal plot shown in the PSCSR. Cadmium appears to remain about the same in well TW-10 and in several of the UBZ-1 springs.

12. Page 26, Section 2.3. The constituent exposure routes presented in this section is oversimplified with respect to sources, pathways, and receptors. This section should have provided a revised conceptual site model based on Phase I results, and an updated conceptual site model based on existing site information should be provided to EPA. This would help focus the reader on those constituent sources and

migration pathways that require further study in Phase II. The risk assessment will examine these this issue in detail.

13. Page 29, Section 3.2. A rationale should be provided as to why none of the remedial technologies selected for consideration in the FS require treatability investigations at this time. In light of the information presented in the PSCR and the Phase II Work Plan, and subsequent discussions between EPA and Monsanto, Monsanto should identify any treatability studies which could be necessary to fully evaluate the groundwater interception, reuse, and treatment (if necessary) option in a timely fashion.
14. Page 29, Section 3.2.1. In addition to identifying potential source areas and the nature and extent of emissions, the Phase II Work Plan should evaluate constituent migration pathways, mobility, and the predictability (where possible) of constituent transport to receptors.

Source emissions such as baghouse and new nodule reclaim area are to be estimated from maximum equipment control efficiency rates. Monsanto should acknowledge that dust control systems are prone to equipment failures, maintenance requirements, and operating errors; and provide a discussion of these limitations in the emission inventory.

15. Page 30, Section 3.2.1. The mass balance approach proposed here appears to rely on a piecemeal approach using data from numerous studies from various time periods. The quality and usability of data from such reports should be evaluated and should be trackable.
16. Page 30, Section 3.2.2. EPA still has not received the supporting data to adequately verify the Phase I air modeling assessment. Supporting data for the mass balance effort and the meteorological investigation will be essential along with a thorough discussion of the limitations and uncertainties of the approaches taken.

On page 6 of the July 15, 1992 letter responding to EPA comments, it was stated that deposition modeling would be included in Phase II. Deposition modeling would provide a means of assessing the potential impacts of constituent migration from emission sources. Monsanto should evaluate deposition with regards to the constituents of concern in off-site soils.

17. Page 30, Section 3.2.3. Since elevated levels of contaminants of concern have been found in the Mormon Springs complex, Monsanto should collect at least one

sediment sample where the Mormon Springs drainage enters Soda Creek.

18. Page 31, Section 3.2.4. Monsanto proposes no additional direct geological investigation during Phase II. In the southernmost cross-section in the PSCSR Monsanto correlates a sand and gravel bed in TW-11 with a clay bed in TW-21, 9 and 35. Golder Associates interpreted the sand and gravel layer (in TW-11) as a possible former stream channel in the 1985 hydrogeological report. Why is this correlation being made? Is it suggested that the clays are overbank deposits in making this correlation. Careful correlation of units needs to be made at the south end of the plant and off site in order to estimate the extent, and throw, of the main fault.
19. Page 31, Section 3.2.5. In the pedological investigation Monsanto is planning to collect samples only in the 0-1 inch range. There were contaminants that exceeded the initial screening in the 0-6 inch range. It is not known if constituents of concern exist deeper in the soil. Monsanto should evaluate the vertical extent of contamination in off-site soils by taking samples at various depths to ascertain the extent of contamination. This information may also be necessary for assessing remedial alternatives.

Additionally, it is stated on this page that soil sampling to the Northeast, east, and southeast is not warranted because air modelling does not predict any significant movement in those directions and because such sampling would be misleading due the presence of other potential sources. EPA and the state remain concerned based on both visual evidence and trace constituents in off-site soil samples taken by Kerr-McGee that constituents of concern which originate on the Monsanto facility are present in off-site soils east of the facility. The phase II soils investigation should be revised to include investigation of soils to the northeast, east, and southeast of the site.

20. Page 31, Section 3.2.6. The text indicates that the plume in the UBZ-4 region is captured by the facility's production wells and that additional characterization activities for this plume are not planned. It should be ensured that changes in the Plant's water supply system are not anticipated. Future changes in the pumping of Monsanto's existing production wells or the use of additional wells could potentially have significant impacts on the hydrogeology and contaminant transport in UBZ-4.
21. Page 34, Section 4.1. Monsanto should identify constituents of concern in on-site source piles and provide data regarding potential worker exposures to such source piles in

areas outside of buildings. This information will help develop the on-site scenarios for risk assessment.

22. Page 35, Section 4.1.1. This section states that an analysis of silt, moisture, and trace constituent content will be conducted. Where moisture is a significant variable (contingent upon frequency of water trucks, amount of water sprayed, etc.) why is moisture content is being measured?
23. Page 36, Section 4.1.2. For the nodule reclaim area and the slag dumping operations, careful consideration of the best available non-sampling method for evaluating air releases is important. A mass balance based on data collected before scrubbers were implemented, process changes were instituted, and production capacity was increased, may not be representative of current conditions. The need for air monitoring should be evaluated.

If sampling and evaluation of the air monitoring filters from the Idaho Department of Health and Welfare, Division of the Environment, Bureau of Air Quality from the vicinity of the plants cannot be achieved, then Monsanto should include air monitoring in Phase II.

24. Page 36, Section 4.1.3. It is uncertain if the proposed activity will be able to fully evaluate the potential contribution of constituents from the vadose zone. Ground water data collected from source areas will provide an indication of what constituents are already present in ground water but do not help characterize the vadose zone, (i.e., secondary source areas). The modeling effort may be able to show if a mechanism exists for leaching contaminants to ground water under average conditions. No mention is made if analytical data, (i.e., leaching tests) for vadose zone materials already exist. Monsanto should verify at this time whether the necessary site-specific data needed for input into the models are available. For example, the surficial geology of the Plant has probably been highly altered due to industrial activities and it seems unlikely that identified potential information sources such as Soil Conservation Service reports would be useful in representing site conditions.
25. Page 39, Section 4.2.2. The constituents to be used in the annual emission rate estimates should be the same as those identified in Table 4-4. The table should also include lead-210, thorium-228, silver, and zinc.
26. Page 40, Section 4.3. This task should also identify the sources and contaminant migration pathways that contribute to elevated constituents in Soda Creek sediments. Cattle

and horses have been observed in the Mormon Creek watershed and are considered potential receptors.

27. Page 40, Section 4.4. The potential impacts from saltation should be discussed as part of the task objective.

In order to evaluate the vertical extent of constituents of concern in soils, Monsanto should identify at least two soil sampling locations in agricultural fields to the south of the Plant and two locations north of the Plant, and collect samples from the 0-1 inch, 0-6 inch, and 6-12 inch depths at each location.

Due to the on-site agricultural practices, it will be necessary to obtain at least one soil sample within the field at the 0-1 and 0-6 inch depths.

It is suggested that the northeastern most soil sampling location be relocated into the agricultural field north of the county road near the Kerr-McGee leased property.

It should be noted that all soil samples be located at least 50 feet from roadways and 100 feet from State Highway-34.

28. Page 41, Section 4.5.1. Additional discussion should be provided on how the results of the electromagnetic (EM) survey will be used to determine placement of the new monitoring wells. In addition, what changes in well placement will occur if the inferred subsidiary fault is not found south of the facility? The PSCSR (page 50) indicates that this fault is believed to die out in this area. According to the schedule, there is only one week between the time of the survey and the beginning of well drilling. EPA must review the EM survey results prior to well installation.

It is unclear why Monsanto proposed the two different target horizons. UBZ 4 is listed as the target horizon on the west side of the fault and UBZ 3 on the east side. Is this change due to the perceived offset along the fault? If so, Monsanto should check their correlations on the cross-section along the southern plant boundary as discussed in Comment #18. Furthermore, the wells with the highest contaminants downgradient of the SX pond, KM-8 and KM-9, one east of and one west of the Finch Springs fault, are screened in UBZ-4.

29. Page 43, Section 4.5.2. The preceding text indicates that five, not six, new monitoring wells will be installed during the Phase II investigation. Please clarify.

The PSCSR (Section 3.6.2.1) indicates that the UBZ contains two or three highly permeable interbed horizons separated by basalt flows. From cross section A-A' (near where most of the new wells will be installed) of that report it appears that the UBZ would consist of at least Basalt Flows V and IV. The Work Plan states that boreholes for the new wells are to be drilled five to ten feet into the unweathered basalt (Basalt Flow III?) underlying the UBZ aquifer. If the intention is being interpreted correctly, it is recommended that conductor casings be installed into the uppermost unweathered basalt layer. This telescoping drilling method would help minimize the potential for introducing contaminants into lower interflow zones within the UBZ. The Work Plan would also benefit by presenting a better description of where exactly the screens of the new wells will be placed. Perhaps a simplified cross section indicating approximate screen depths of proposed wells could be provided.

30. Page 44, Section 4.5.3 and Table 4-5. Radon-222 should be added to the sampling list. This constituent exceeded the proposed drinking water standard in certain wells in each aquifer. Since there is not enough evidence to ascertain if the radon is naturally occurring at the levels indicated by the October 1991 sampling results, Monsanto should evaluate this issue in Phase II.
31. Page 46, Section 4.5.5 and SOP TP-1.4-12. Ideally, Monsanto's production wells would be shut down for the duration of the aquifer pump test or pumped at a constant rate since it may be difficult to correct drawdown and recovery data for the effects of the production wells starting and stopping. However, it is realized that it will be impractical to shut down the facility's production wells for several days. The impact of production wells on UBZ-2 observation wells would obviously be diminished if the main fault is truly acting as a barrier to ground water flow. However, this phenomenon has not been entirely substantiated with the existing site investigations. In addition, the fault is believed to be hinged and it is quite possible that hydraulic properties of the fault zone could change laterally along the fault. Determining the hydraulic effect of the fault is a primary objective of performing the pumping tests. The Work Plan should address specifically how the impact of operating production wells will be taken into account.
32. Page 46, Section 4.5.5. This section indicates that Monsnato will perform the Fluoride analysis on some groundwater samples. Monsanto should provide EPA with a laboratory QA plan for the files.

33. Page 48, Section 4.6.1. The proposed field inspection should include an inventory of the local cattle herds; residence time and diet in pastures within 2km of the Plant, stock watering sources, and who consumes the beef. Garden produce in the nearby residential areas should also be evaluated. Monsanto should ensure the integrity and non-biased nature of the interviews.
34. Table 4-1: Lead-210, Thorium-228 and Th-232 should be added to the constituent list. For Table 4-3, Lead-210, Arsenic and Radium-228 should be included; and for Table 4-4, Lead-210, Silver, Thorium-228, and Zinc should be added.
35. Page 49, Section 5. Monsanto is encouraged to provide EPA with constructive suggestions for shortening the RI/FS schedule wherever feasible.
36. QA Plan Figure 2-1 indicates that an alternate laboratory has been selected to provide analytical support. Monsanto should provide EPA with a laboratory QA plan for that facility.
37. QA Plan Table 7-1. The footnote for the flouride method should be "4" rather than "5".

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**SAIC**  
*Science Applications International Corporation*  
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**Technology Services Company**

September 3, 1992

DCN: TZ4-C10019-EP-11592

Mr. Timothy Brincefield  
U.S. EPA Region 10  
1200 Sixth Avenue (HW-113)  
Seattle, WA 98101

Subject: EPA Contract 68-W9-0008, WA # C10019  
Monsanto RI/FS Oversight  
Draft Preliminary Identification of Contaminants of Concern

Dear Mr. Brincefield:

SAIC/TSC has conducted an initial screening of Phase I data to identify potential contaminants of concern at the Monsanto, Soda Springs facility. This document is meant to combine the July 21st revised screening of inorganics and the August 17th radionuclide screening. The screening analysis herein is considered preliminary and is based on the available data collected thus far. Further screening for potential contaminants of concern and a more thorough analysis of exposure will be necessary as more data are received.

This report contains the corrections to the list of potential contaminants of concern given in the draft July 9th report, based on further scrutiny of Tables 1 and 4, as well as calculating the revised radionuclide risk-based concentrations from the revised calculations as seen in Part B of the RAGS, pages 35-39. (Changes encountered in the risk-based concentrations between the "new" and the "old" equation are listed below.)

Nickel has been removed as a contaminant of concern in soils, based on the reference concentration which was not exceeded at the HI=1 or the HI=0.1 level. Uranium was removed as a potential constituent of concern in offsite soils at the 0-6" soil depth, and Radium-228 was removed from the shallow fresh water aquifer. The only additions to the analyte list from the previous screening are Manganese in the 0-6" soil depth, and Thorium-228 in onsite source piles. Since the draft July 9 screening, the onsite source pile analysis (Tables 1A, 2A, and 6), as well as a list of discrepancies between the Preliminary Site Characterization Report provided by Golder, Assoc. and this analysis.

Finally, we have evaluated the need for further characterization of background radionuclide concentrations for the purpose of risk assessment screening. A discussion summarizing our findings is included.

Changes in Reference Concentrations as a Result of Revised Equation

RADIONUCLIDE	OLD RFC, WATER/SOIL	NEW RFC, WATER/SOIL	CHANGE
K-40	6/70	1.2/0.08	decreased 5x, decreased 900x
Pb-210	0.1/1.5	0.009/1.5	decreased 10x, no change
Po-210	0.32/5.1	0.005/1.2	decreased 60x, decreased 4x
Ra-226	0.4/6.4	0.4/2.3	no change, decreased 3x
Ra-228	0.5/7.7	0.5/7.9	no change, no change
Th-228	0.9/14	0.0002/0.007	decreased 4500x, decreased 2000x
Th-230	3.7/59	3.7/57	no change, no change
Th-232	4/64	4/64	no change, no change
U-234	3/48	3/48	no change, no change
U-235	3/48	3/0.17	no change, decreased 300x
U-238	1.7/27	3/48	increased 2x, increased 2x
Rn-222	51	11/33	decreased 5x

It is important to note that the new values given above and the results of this screening may not be final. Radionuclide screening reference concentrations may be subject to change as the EPA confirms and verifies its equation.

Mr. Tim Brincefield  
September 3, 1992  
Page 3 of 3



We have also included a disk containing this report and the tables herein. The format of the tables is Quattro-Pro (similar to Lotus) except Table 3, which is in WordPerfect 5.1.

If you have any questions regarding this document, please contact Ms. Mona R. Kimbell or myself at 485-2818.

Sincerely,

Technology Services Company, A Division of  
SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

A handwritten signature in cursive script that reads "James C. Eldridge".

James C. Eldridge  
Environmental Scientist  
Work Assignment Manager

Enclosure:

cc: P. Rubenstein, EPA (letter only)  
M. Kimbell, SAIC/TSC  
M. Mackenzie-Carter, SAIC, Idaho Falls  
V. Rao, SAIC/TSC

REVISED DRAFT  
PRELIMINARY IDENTIFICATION OF CONTAMINANTS OF CONCERN  
PHASE I REMEDIAL INVESTIGATION  
MONSANTO CORPORATION

## I INTRODUCTION

Concentrations of analytes in ground water and offsite soils are compared to USEPA Region 10 default residential scenario risk-based concentrations. Onsite source pile analyte concentrations are compared to USEPA Region 10 default industrial exposure risk-based concentrations. Ground water concentrations are also compared to MCLs, SMCLs, and MCLGs, as well as Human Health Water Quality Criteria. An ecological evaluation is performed using tentative ecological risk screening levels and comparing these to offsite soil concentrations. Concentrations of cadmium predicted in air from Monsanto's air modeling assessment are compared to the default inhalation reference concentration. In this preliminary analysis, the maximum soil and ground water background concentrations are shown for comparison.

## II BACKGROUND CONCENTRATIONS

The maximum soil background concentrations are obtained from the combined data set (Monsanto's BAK 1-3 and Kerr-McGee's BAK 5-7). (Kerr-McGee samples BAK-1 through BAK-4 are not used due to their close proximity to the potential area of impact.) Background concentrations used to compare analyte concentrations in onsite source piles are maximum values from the shallow soil depth, only. The maximum background ground water concentrations for fresh water are derived from Kerr-McGee and Monsanto data at Formation Spring and Ledger Springs. Background water concentrations for sodic waters are the maximum values from TW-28, TW-29, and Hooper Spring.

## III RISK-BASED CONCENTRATIONS

Risk-based concentrations in soil, water, and air are derived using reference doses and slope factors from IRIS, the HEAST Tables (March 1992) and the U.S. EPA Environmental Criteria and Assessment Office. Equations are written using EPA default exposure assumptions for residential and industrial scenarios with target risks of  $1E-6$  and  $1E-7$  for carcinogens, and hazard indices (HI) of 0.1 and 1.0 for noncarcinogens. Risk-based concentrations for radionuclides are calculated using the HEAST Table Slope Factors and residential and industrial exposure default parameters as set forth in the Risk Assessment Guidance, Part B<sup>1</sup>. Table

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<sup>1</sup>. Discrepancies existed between methods of calculation for risk-based concentrations of radionuclides, at the time of the draft July 9 screening; these have been corrected but are still currently undergoing a review process by the EPA.

1 and 1A list the risk-based concentrations of inorganic compounds in soil, water, and air, based on residential and industrial scenarios, respectively. Table 2 lists the radionuclide risk-based concentrations in soil and water, based on a residential scenario. Table 2A lists risk-based concentrations for radionuclides in soil and air, based on an industrial scenario.

Preliminary ecological reference concentrations for inorganics in the soil are provided in Table 3. These reference concentrations are considered conservative for screening purposes. Only chemicals in offsite soils will be evaluated quantitatively for potential ecological concern. A more detailed explanation of the concentrations and their endpoint effects will be included in a Preliminary Ecological Evaluation Report scheduled for a later date.

#### IV SOILS

Results of the screening for potential contaminants of concern in offsite soils are shown in Table 4. Soil depths of 0-1" and 0-6" have been analyzed separately.

For an analyte to be retained as a potential contaminant of concern, the following conditions must be met:

- The analyte concentration is greater than the method detection limit.
- The analyte concentration is equal to or greater than the maximum background concentration.
- The analyte concentration exceeds the health-based risk concentration.

In cases where a health-based risk concentration is not available, the analyte is retained as a contaminant of concern if it exceeds background. There are risk-based concentrations which fall below the maximum detected background concentration, especially at the HI=0.1 level of risk. In such a case, the analyte is retained if the range of concentrations in the media exceeds the risk-based concentration, although the number of exceedences/# samples is replaced with a < bckgd symbol. Beryllium and Arsenic are exceptions to the above outlined procedure; since the risk-based concentrations in soil based on carcinogenicity are more than an order of magnitude less than maximum background, exceedences of these values are not considered valid criteria for retaining the analyte as a constituent of concern.

Potential contaminants of concern for ecological risks are evaluated by comparing media concentrations of specific analytes to the concentrations found in Table 3. Ecological reference values for radionuclides are still being reviewed as information becomes available.

The following is a list of potential contaminants of concern in offsite soils, following the risk-based screening:

1. 0-1" SOIL DEPTH

#### Human Health

Aluminum, Arsenic, Cadmium, Chromium VI, Vanadium, Lead-210, Polonium-210, Radium-226, and Thorium-230

#### Ecological

Arsenic, Cadmium, Chromium VI, Silver, Vanadium, and Zinc

### 2. 0-6" SOIL DEPTH

#### Human Health

Aluminum, Arsenic, Cadmium, Manganese, Vanadium, Lead-210, Polonium-210, Radium-226, Thorium-228, and Thorium-230

#### Ecological

Cadmium, Chromium VI, Manganese, Silver, Vanadium, and Zinc

## V GROUND WATER

Screening results for potential contaminants of concern in ground water are shown in Table 6 and summarized below. Water sample source locations are analyzed in three separate groups; Fresh Water (Shallow), the Mead Thrust Aquifer, and Sodic Water (the Chesterfield Aquifer), as defined in the Phase I Preliminary Site Characterization Report.

Regarding the use of filtered versus unfiltered samples, a final decision has not been reached on the criteria for using filtered samples. The only filtered samples used in this analysis include TW-38, 43, and 50. Following an analysis of the filtered and unfiltered data from the Phase I Report, unfiltered data were used for the remaining wells based on turbidity and degree of variation between the analyte concentration in the samples. Fluoride, Sulfate Ion, and Nitrate as N were not analyzed in the filtered samples, as well as selected radionuclides.

Split samples for wells TW-10, 12, 20, 22, 36, 37, Harris, and the Mormon Spring, as analyzed by EA Laboratories of Sparks, Maryland, (USEPA Contract Lab), have been included in this analysis.

Criteria for retaining analytes as potential contaminants of concern in ground water follows the same procedure as previously outlined for soils, with the inclusion of drinking water standards. However, an exceedence of an MCLG of 0 is not considered sufficient information to retain an analyte as a contaminant of concern.

The following is a list of potential contaminants of concern in ground water in each of the three previously mentioned aquifers, following the risk-based screening<sup>2</sup>:

1. FRESH WATER, SHALLOW

Human Health

Aluminum, Arsenic, Cadmium, Chloride, Chromium VI, Fluoride, Iron, Manganese, Molybdenum, Nickel, Nitrate as N, Selenium, Sulfate Ion, Vanadium, Zinc, and Radon-222.

2. FRESH WATER, MEAD THRUST

Human Health

Aluminum, Arsenic, Chloride, Chromium VI, Fluoride, Iron, Molybdenum, Nitrate as N, Sulfate Ion, Vanadium, and Radon-222

3. SODIC WATER, CHESTERFIELD AQUIFER

Human Health

Aluminum, Arsenic, Cadmium, Chromium VI, Fluoride, Iron, Manganese, Molybdenum, Selenium, Sulfate Ion, and Radon-222.

VI ONSITE SOURCE FILES

Onsite source piles are screened for comparison to background and industrial scenario risk-based concentrations. Results of this analysis are shown in Table 6. Criteria for retaining analytes as potential contaminants of concern are the same as for soils, with two exceptions: 1) An industrial scenario is used for the risk-based screening as opposed to a residential scenario. 2) Exceedences of the carcinogenic risk-based concentrations for arsenic and beryllium are considered valid criteria for retaining these analytes as potential contaminants of concern. (The reference concentrations for arsenic and beryllium, under the industrial scenario, are close to and greater than the maximum background concentrations, respectively.)

This risk-based screening identifies the following analytes as potential contaminants of concern in onsite source piles:

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<sup>2</sup>. Although concentrations of calcium, magnesium, and potassium were found in excess of the maximum background by two to more than ten times, these analytes were not considered contaminants of concern due to a wide range of tolerances and a lack of toxicological concern.

## Human Health

Arsenic, Beryllium, Cadmium, Chromium VI, Vanadium, Lead-210, Polonium-210, Radium-226, Thorium-228, Thorium-230, and Uranium.

## VII AIR

An air modeling assessment was conducted by Monsanto and their contractors to predict concentrations of cadmium, fluoride, TSP, and PM<sub>10</sub> at various receptor locations. A comparison of the predicted air concentrations of cadmium with the carcinogenic reference concentration of 1.4E-6 mg/m<sup>3</sup> (referring to a risk of one in a million) indicates that the reference concentration is exceeded at all receptor locations. A source specific analysis indicates that the permitted sources contribute more than 99% of the cadmium emissions.

The usability of model predicted air concentrations in evaluating the human health risks from air emissions is limited, even for a preliminary screening. For example, the EPA suggests using the PM<sub>10</sub> of *specific contaminants* for inhalation estimates. Analyte-specific PM<sub>10</sub> concentrations would decrease the uncertainty in predicting human health risk from the air pathway. Also, cadmium and fluoride do not represent the sum total of potential contaminants of interest in air emissions.

## VIII SEDIMENTS

A risk based screening of sediments from Soda Creek is deferred to a later time.

## IX SUMMARY

It is important to note that data from the May 1992, sampling round and future data to be collected in Phase II will be used to update and/or modify the list of potential contaminants of concern.

Offsite soils appear to indicate elevated levels of 11 of the 25 constituents analyzed, in excess of the maximum background and reference concentrations using the residential scenario. Differences between soil depths have not been shown to be insignificant at this point in time and are analyzed separately. Potential contaminants of concern are the same in both groups with the exceptions of chromium VI (found only in the 0-1" level), manganese (found only in the 0-6" depth), and radium-228 (elevated in the 0-6" level but not the 0-1" level).

Further information and analysis of filtered versus unfiltered water sample data may also modify the list of potential contaminants of concern. A decision was made in this analysis to use both, depending on the turbidity of the original sample and the differences between analyte concentrations in the filtered versus the unfiltered data samples.

Water samples from three aquifers also appear to indicate elevated levels of constituents analyzed, in excess of the reference concentrations using a residential scenario, and regulatory values. In the fresh water shallow aquifer, all analytes except beryllium, calcium, copper, lead, magnesium, potassium,

silver, radium-226, radium-228, and uranium (total) are retained as potential contaminants of concern. In the Mead Thrust and Chesterfield aquifers, 11 of the 26 analytes are retained as potential contaminants of concern, including one radionuclide.

Comparison of the constituent concentration in onsite source piles to industrial risk-based reference concentrations indicates elevated levels of 11 of the 25 constituents analyzed. The source piles most often exceeding reference concentrations of inorganic analytes are the underflow solids (62% of exceedences) and the slurry ponds (24% of exceedences). Baghouse dust samples constitute 14% of the exceedences and no reference concentrations for inorganic analytes are exceeded in the slag pile samples. Radionuclide concentrations in source piles are exceeded for all locations. Baghouse dust sample #1 exceeds only the reference concentrations for Lead-210 and Radium-226, at the  $10^{-7}$  level of risk. The sources found to be highest in radionuclides vary with isotope; Uranium, Thorium, and Radium are highest in the slag piles, whereas Lead-210 and Polonium-210 are highest in the underflow solids.

The air pathway as analyzed by modelling estimates appears to indicate elevated concentrations of cadmium at all discreet receptor locations, when compared to the carcinogenic risk reference values.

#### X CONSISTENCY OF RESULTS WITH GOLDER, ASSOC.

Results from the Preliminary Site Characterization Summary Report on the Monsanto, Soda Springs site are compared to these results. With the exception of beryllium in soils, all of the potential contaminants of concern which were retained by Golder, Associates are retained in this report. Other constituents are added as described below, followed by a brief explanation of why the analysis by Golder, Associates may not have included it.

##### Soil, 0-1"

- Aluminum (Golder did not have a RfD for Aluminum)
- Chromium (Golder used the RfD for Chromium +3, not +6)
- Vanadium (Golder used an HI of 0.5 instead of 0.1)

##### Soil, 0-6"

- Aluminum (same as above)
- Cadmium (Golder used an HI of 0.5 instead of 0.1)
- Vanadium (same as above)

##### Water, Shallow Fresh Water

- Aluminum (Golder's calculated UTL was not exceeded.)
- Beryllium ( " )
- Chromium ( " )
- Iron ( " )
- Molybdenum (Not analyzed by Golder, Assoc.)

Vanadium (Golder's calculated UTL was not exceeded.)  
Radon-222 ( " )

Water, Mead Thrust Aquifer (not analyzed by Golder, Assoc.)

Water, Chesterfield Aquifer

Aluminum (Golder's calculated UTL was not exceeded.)  
Arsenic ( " )  
Chromium ( " )  
Iron ( " )  
Manganese ( " )  
Molybdenum (Not analyzed by Golder, Assoc.)  
Radon-222 (Golder's calculated UTL was not exceeded.)

## XI RECOMMENDATIONS

Based on the results of this preliminary screening, it is recommended that

- Future water sampling include the following constituents in analyses:

Fresh water, Shallow: Aluminum, Arsenic, Cadmium, Chloride, Chromium, Fluoride, Iron, Manganese, Molybdenum, Nickel, Nitrate as N, Selenium, Sulfate Ion, Vanadium, Zinc, and Radon-222

Fresh Water, Mead Thrust Aquifer: Aluminum, Arsenic, Chloride, Chromium, Fluoride, Iron, Molybdenum, Nitrate as N, Sulfate Ion, Vanadium, and Radon-222

Sodic Water, Chesterfield Aquifer: Aluminum, Arsenic, Cadmium, Chromium, Fluoride, Iron, Lead, Manganese, Molybdenum, Selenium, Sulfate Ion, and Radon-222

- Future soil sampling include both the 0-1" layer and the 0-6" layer, and include analysis of the following constituents:

0-1" Soils: Aluminum, Arsenic, Cadmium, Chromium VI, Vanadium, Lead-210, Polonium-210, Radium-226, Thorium-230, and Uranium-238

0-6" Soils: Aluminum, Arsenic, Cadmium, Manganese, Vanadium, Lead-210, Polonium-210, Radium-226, Thorium-228, and Thorium-230

- Air modelling should include compound-specific  $PM_{10}$  values for the following analytes which were found in offsite soils and indicated increased health risks, and for which there is inhalation toxicity data available; Arsenic, Chromium VI, Manganese, Lead-210, Polonium-210, Radium-226, Thorium-228, Thorium-230, and Uranium-238.

## XII RADIONUCLIDE SAMPLING FOR BACKGROUND

With regard to this screening, it is important to realize that the characterization of background may play a significant role when the risk-based reference concentrations are below the reported background values. One illustration of the need to characterize background for screening is the case with Radon-222. Radon-222 has been retained as a contaminant of concern in ground water in two of the three Monsanto aquifers, even though the maximum background value was not exceeded. This is due to the exceedingly high background value of 2200 pCi/l, which is seven times greater than the MCL of 300 pCi/l. Further characterization of Radon-222 as a potential contaminant of concern in ground water at the Monsanto facility should be evaluated.

The number of samples used in determining background concentrations greatly influences the accuracy of background prediction. Background determinations are based on only three samples for the following radionuclides; Po-210, U-234, U-235 and U-238 in soil, and Ra-226, Ra-228, Rn-222 and U-238 in water. Variability between samples also greatly influences the accuracy of prediction of background concentrations. High variability (defined here as having a standard deviation which is more than 50% of the mean) is observed for Ra-226 and Rn-222 in background water samples, as well as Th-230 and U-238 in background soil samples. This means that background for at least these four constituents has not been adequately characterized. However, further sampling for background at this stage is unnecessary, as explained below.

Further background sampling will not be necessary in Phase II for radionuclides in water, with the exception of Radon-222. The MCL of 20 pCi/l and even the old MCL of 5 pCi/l for Ra-226 was not exceeded by any of the ground water or background samples.

Th-230 is a constituent of concern in both the source piles and the off site soils, at both soil depths. Total Uranium (assumed to be >99% U-238) is also a constituent of concern in both source piles and off site soils. Further characterization of the background values for these constituents would not enhance the screening of solid media at the Monsanto facility at this time.

## XIII RADON AS A DATA GAP

It is noted that most of the contaminants of concern identified to date in on-site source piles and off site soils are constituents of the Uranium series decay chain. Radon-222 is an important link in this decay series, especially as a precursor to lead-210 and polonium-210. Data for radon-222 are currently not available for this site. Radon emissions in total curies/year from another thermal phosphorous production plant in 1982<sup>3</sup> were projected to be 8 times higher than total curie emissions/year from lead-210 and polonium-210, combined.

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<sup>3</sup>. Emissions of Naturally Occurring Radioactivity: Monsanto Elemental Phosphorous Plant, U.S. Office of Radiation Programs, November 1982. PB83-150698, EPA 520 6 82 021.

Table 1  
Risk-Based Concentrations in Water, Soil, and Air in a Residential Scenario @ HI=1.0  
and a target risk of 1E-6

(Inorganics) ANALYTE	Noncarcinogenic		Carcinogenic		Noncarcinogenic			Carcinogenic		
	(mg/kg/day)	(mg/m3)	(mg/kg/day)-1		RBC Water	RBC Soil	RBC Air	RBC Water	RBC Soil	RBC Air
	Oral RfD	Inhal. RfC	Oral SF	Inhal. SF	(mg/l)	(mg/kg)	(mg/m3)	(mg/l)	mg/kg	(mg/m3)
Aluminum	1.0E+00	ND	ND	ND	3.8E+01	2.7E+05	ND	ND	ND	ND
Ammonia	9.7E-01	1.0E-01	ND	ND	3.5E+01	2.7E+05	3.6E+01	ND	ND	ND
Antimony	4.0E-04	ND	ND	ND	1.5E-02	1.1E+02	ND	ND	ND	ND
Arsenic	3.0E-04	ND	1.75	5.0E+01	1.1E-02	8.2E+01	ND	4.9E-05	3.7E-01	1.7E-07
Barium	7.0E-02	ND	ND	ND	2.6E+00	1.9E+04	ND	ND	ND	ND
Beryllium	5.0E-03	ND	4.3	8.4E+00	1.8E-01	1.4E+03	ND	2.0E-05	1.5E-01	1.0E-06
Cadmium	5.0E-04	ND	ND	6.1E+00	1.8E-02	1.4E+02	ND	ND	ND	1.4E-06
Calcium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium III	1.0E+00	ND	ND	ND	3.6E+01	2.7E+05	ND	ND	ND	ND
Chromium VI	5.0E-03	ND	ND	4.1E+01	1.8E-01	1.4E+03	ND	ND	ND	2.1E-07
Cobalt	ND	ND	ND	ND	ND	0.0E+00	ND	ND	ND	ND
Copper	3.7E-02	ND	ND	ND	1.4E+00	1.0E+04	ND	ND	ND	ND
Fluoride	6.0E-02	ND	ND	ND	2.2E+00	1.6E+04	ND	ND	ND	ND
Iron	ND	ND	ND	ND	ND	0.0E+00	ND	ND	ND	ND
Manganese	1.0E-01	4.0E-04	ND	ND	3.6E+00	2.7E+04	9.1E+03	ND	ND	ND
Mercury	0.0003	ND	ND	ND	1.1E-02	8.2E+01	ND	ND	ND	ND
Molybdenum	5.0E-03	ND	ND	ND	1.8E-01	1.4E+03	ND	ND	ND	ND
Nickel	2.0E-02	ND	ND	8.4E-01	7.3E-01	5.5E+03	ND	ND	ND	1.0E-05
Nitrate as N	1.6E+00	ND	ND	ND	5.8E+01	4.4E+05	ND	ND	ND	ND
Selenium	5.0E-03	ND	ND	ND	1.8E-01	1.4E+03	ND	ND	ND	ND
Silver	5.0E-03	ND	ND	ND	1.8E-01	1.4E+03	ND	ND	ND	ND
Titanium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	7.0E-03	ND	ND	ND	2.6E-01	1.9E+03	ND	ND	ND	ND
Zinc	2.0E-01	ND	ND	ND	7.3E+00	5.5E+04	ND	ND	ND	ND

ND=Not Determined

Table 1A  
Risk-Based Concentrations in Water, Soil, and Air in a Worker Scenario @ HI=1.0  
and a target risk of 1E-6

(Inorganics) ANALYTE	Noncarcinogenic		Carcinogenic		Noncarcinogenic			Carcinogenic		
	(mg/kg/day)	(mg/m3)	(mg/kg/day)-1		RBC Water	RBC Soil	RBC Air	RBC Water	RBC Soil	RBC Air
	Oral RfD	Inhal. RfC	Oral SF	Inhal. SF	(mg/l)	(mg/kg)	(mg/m3)	(mg/l)	mg/kg	(mg/m3)
Aluminum	1.0E+00	ND	ND	ND	1.0E+02	2.0E+06	ND	ND	ND	ND
Ammonia	9.7E-01	1.0E-01	ND	ND	9.9E+01	2.0E+06	5.1E-01	ND	ND	ND
Antimony	4.0E-04	ND	ND	ND	4.1E-02	8.2E+02	ND	ND	ND	ND
Arsenic	3.0E-04	ND	1.75	5.0E+01	3.1E-02	6.1E+02	ND	1.6E-04	3.3E+00	2.9E-07
Barium	7.0E-02	ND	ND	ND	7.1E+00	1.4E+05	ND	ND	ND	ND
Beryllium	5.0E-03	ND	4.3	8.4E+00	5.1E-01	1.0E+04	ND	6.6E-05	1.3E+00	1.7E-06
Cadmium	5.0E-04	ND	ND	6.1E+00	5.1E-02	1.0E+03	ND	ND	ND	2.3E-06
Calcium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium III	1.0E+00	ND	ND	ND	1.0E+02	2.0E+06	ND	ND	ND	ND
Chromium VI	5.0E-03	ND	ND	4.1E+01	5.1E-01	1.0E+04	ND	ND	ND	3.5E-07
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper	3.7E-02	ND	ND	ND	3.8E+00	7.6E+04	ND	ND	ND	ND
Fluoride	6.0E-02	ND	ND	ND	6.1E+00	1.2E+05	ND	ND	ND	ND
Iron	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manganese	1.0E-01	4.0E-04	ND	ND	1.0E+01	2.0E+05	2.0E-03	ND	ND	ND
Mercury	0.0003	ND	ND	ND	3.1E-02	6.1E+02	ND	ND	ND	ND
Molybdenum	5.0E-03	ND	ND	ND	5.1E-01	1.0E+04	ND	ND	ND	ND
Nickel	2.0E-02	ND	ND	8.4E-01	2.0E+00	4.1E+04	ND	ND	ND	1.7E-05
Nitrate as N	1.6E+00	ND	ND	ND	1.6E+02	3.3E+06	ND	ND	ND	ND
Selenium	5.0E-03	ND	ND	ND	5.1E-01	1.0E+04	ND	ND	ND	ND
Silver	5.0E-03	ND	ND	ND	5.1E-01	1.0E+04	ND	ND	ND	ND
Vanadium	7.0E-03	ND	ND	ND	7.1E-01	1.4E+04	ND	ND	ND	ND
Zinc	2.0E-01	ND	ND	ND	7.3E+00	4.1E+05	ND	ND	ND	ND

ND=Not Determined

Table 2  
Calculation of Risk-Based Concentrations of Radionuclides in Water and Soil  
Residential Scenario

Assumptions Used in Soil Calculation\*: Target Excess Risk =  $1 \text{ E-}6$ ,

Exposure Frequency = 350 days/yr and 30 yr,

Age-Adjusted Soil Ingestion Factor = 3600 mg-yr/day

Radionuclide	Oral SF (risk/pCi)	Inhal. SF (risk/pCi)	Extern. SF (risk/yr/pCi/g)	Water RBC (pCi/l) Ingest. + Inhalation	Soil RBC (pCi/g) Ingest. + External
K-40	1.1E-11	7.6E-12	5.4E-07	1.2E+00	7.7E-02
Pb-210	5.1E-10	1.3E-09	1.3E-10	8.8E-03	1.5E+00
Pb-210+D	6.6E-10	1.3E-09	1.6E-10	8.6E-03	1.2E+00
Po-210	1.5E-10	2.6E-09	2.9E-11	4.8E-03	5.3E+00
Rn-222	1.4E-12	7.3E-13	1.2E-09	1.1E+01	3.3E+01
Rn-222+D	1.7E-12	7.7E-12	5.9E-06	1.6E+00	7.1E-03
Ra-226	1.2E-10	3.0E-09	1.2E-08	4.0E-01	2.3E+00
Ra-226+D	1.2E-10	3.0E-09	6.0E-06	4.0E-01	6.9E-03
Ra-228	1.0E-10	6.6E-10	0.0E+00	4.8E-01	7.9E+00
Ra-228+D	1.0E-10	6.9E-10	2.9E-06	4.8E-01	1.4E-02
Th-228	5.5E-11	7.8E-08	5.6E-06	1.6E-04	7.4E-03
Th-230	1.3E-11	2.9E-08	5.4E-11	3.7E+00	5.7E+01
Th-232	1.2E-11	2.8E-08	2.6E-11	4.0E+00	6.4E+01
U-234	1.6E-11	2.6E-08	3.0E-11	3.0E+00	4.8E+01
U-235	1.6E-11	2.5E-08	2.4E-07	3.0E+00	1.7E-01
U-238	1.6E-11	2.4E-08	2.1E-11	3.0E+00	4.8E+01
U-238+D	2.8E-11	5.2E-08	3.6E-08	1.7E+00	1.1E+00

SF = Slope Factor (Values derived from the Health Effects Assessment Summary Tables, March, 1992.)

RBC = Risk-based concentration for radionuclides in residential media, using revised equation from the RAGS, Part B, p. 35-37.

Table 2A  
Calculation of Risk-Based Concentrations of Radionuclides in On-Site  
Source Piles, Worker Scenario

Assumptions Used in Soil Calculation\*: Target Excess Risk =  $1 \text{ E-}6$ ,

Exposure Frequency = 250 days/yr and 25 yr,

Daily Soil Ingestion Rate = 50 mg/day

Radionuclide	Oral SF (risk/pCi)	Inhal. SF (risk/pCi)	Extern. SF (risk/yr/pCi/g)	Soil RBC (pCi/g) Ingest. + External
K-40	1.1E-11	7.6E-12	5.4E-07	9.3E-02
Pb-210	5.1E-10	1.3E-09	1.3E-10	6.2E+00
Pb-210+D	6.6E-10	1.3E-09	1.6E-10	4.8E+00
Po-210	1.5E-10	2.6E-09	2.9E-11	2.1E+01
Rn-222	1.4E-12	7.3E-13	1.2E-09	4.1E+01
Rn-222+D	1.7E-12	7.7E-12	5.9E-06	8.5E-03
Ra-226	1.2E-10	3.0E-09	1.2E-08	3.6E+00
Ra-226+D	1.2E-10	3.0E-09	6.0E-06	8.3E-03
Ra-228	1.0E-10	6.6E-10	0.0E+00	3.2E+01
Ra-228+D	1.0E-10	6.9E-10	2.9E-06	1.7E-02
Th-228	5.5E-11	7.8E-08	5.6E-06	8.9E-03
Th-230	1.3E-11	2.9E-08	5.4E-11	2.0E+02
Th-232	1.2E-11	2.8E-08	2.6E-11	2.4E+02
U-234	1.6E-11	2.6E-08	3.0E-11	1.8E+02
U-235	1.6E-11	2.5E-08	2.4E-07	2.1E-01
U-238	1.6E-11	2.4E-08	2.1E-11	1.9E+02
U-238+D	2.8E-11	5.2E-08	3.6E-08	1.4E+00

RBC = Risk-based concentration for radionuclides in industrial media

SF = Slope Factor (Values derived from the Health Effects Assessment Summary  
Tables, March, 1992.)

As calculated from the revised RAGS, Part B, p. 39

Table 3  
Soil Reference Concentrations<sup>a</sup> (mg/kg)  
for Ecological Screening

Analyte	Phytotoxic	Toxic to Soil Fauna
Aluminum	-	-
Antimony	12	-
Arsenic	25	50
Barium	-	-
Beryllium	-	-
Cadmium	10	20
Calcium	-	-
Chromium	100	-
Cobalt	-	-
Copper	100	60
Fluoride	200	-
Iron	-	-
Lead	200	250
Magnesium	-	-
Manganese	1,500	-
Molybdenum	-	-
Nickel	100	-
Selenium	5	-
Silver	4	-
Titanium	-	-
Vanadium	100	-
Zinc	250	-

<sup>a</sup> Derived from the following Sources:  
Kabata-Pendias, A and Pendias, H. (1991)  
ICF, Inc (1989)  
Adriano, D.C. (1986)  
Antonovics, J., et. al (1971)  
Chaney, R.L. (1980)  
CH2M Hill (1986a, 1986b)  
Davis, R.D. et. al (1978)  
Demayo, A, et. al (1982)  
Eisler, R. (1985 - 1988)  
Tyler, et. al (1989)  
Balsberg - Pahlsson (1989)

Table 4  
Revised Preliminary Data Screening for Potential Contaminants of Concern in Off-site Soil, Monsanto

TWO SOIL DEPTHS REPRESENTED

(Values are given in units of mg/kg.)

Analyte	Range of site Concentrations	Maximum Background	#exceed. /#samples	Noncancer RfCs (Residential)		Carcinogenic RfCs 1E-06
				HI=0.1	HI=1	
Aluminum (0-1')	(15400-30200)	18500	12/16	2.7E+04	1/16	2.7E+05
Aluminum (0-6')	(15800-45100)	17400	18/21	-	13/21	-
Arsenic	(2.6-34)	5.2	11/16	8.2E+00	7/21	8.2E+01
	(1.7-10)	6	13/21	-	13/21	-
Beryllium	(1-4.0)	1	12/16	1.4E+02	-	1.4E+03
	(1-3.5)	1	16/21	-	-	-
Cadmium	(6.5-168)	9.7	12/16	1.4E+01	10/16	1.4E+02
	(3.3-67.3)	7	17/21	-	11/21	-
Chromium VI	(19-325)	18	16/16	1.4E+02	4/16	1.4E+03
	(40-130)	16.7	21/21	-	-	-
Copper	(12-42)	19.6	10/16	1.1E+03	-	1.1E+04
	(2-30)	22.8	2/21	-	-	-
Fluoride	(6.5-102.6)	46.6	4/16	1.6E+03	-	1.6E+04
	(nondetect-85)	66.1	3/21	-	-	-
Iron	(9990-24100)	19200	2/16	-	-	-
	(34-55500)	23000	9/21	-	-	-
Lead	(nondetect-68)	39	5/16	500*	-	-
	(18-39)	81	-	-	-	-
Manganese	(170-1380)	696	2/16	2.7E+03	-	2.7E+04
	(410-3440)	681	2/21	-	1/21	-
Nickel	(14-87.3)	43	6/16	5.5E+02	-	5.5E+03
	(25-52)	53	-	-	-	-
Nitrate as N	(2.1-47)	13	5/16	4.4E+04	-	4.4E+05
	(2.1-22)	12	4/21	-	-	-
Selenium	(nondetect-3.2)	0.8	9/16	1.4E+02	-	1.4E+03
	(nondetect-2.4)	0.8	15/21	-	-	-
Silver	(nondetect-8.5)	1	12/16	1.4E+02	-	1.4E+03
	(nondetect-8.5)	1	10/21	-	-	-
Vanadium	(29-467)	42	13/16	1.9E+02	6/16	1.9E+03
	(22-200)	42	16/21	-	1/21	-
Zinc	(91.9-2670)	123	15/16	5.5E+03	-	5.5E+04
	(80-2290)	78.3	21/21	-	-	-

Reference values which are below the detection limit have been indicated.

Shading indicates exceedance of column value; shading in the analyte column indicates that the analyte has been retained as a constituent of concern following a risk-based screening.

Table 4 (continued)  
Revised Preliminary Data Screening for Potential Contaminants of Concern in Off-site Soil, Monsanto

(Values are given in units of pCi/g)

Analyte	Range of Site Concentrations	Maximum		Radionuclide RfCs (Residential)	
		Background	#exceed. /#samples	Risk of 10-7	Risk of 10-6
Lead-210	(2.6-65)	3	14/15	1.5E-01 <bckgd	1.5E+00 <bckgd
	(1.8-32)	2.2	14/16		-
K-40	(7.3-19)	20	-	7.7E-03 <bckgd	7.7E-02 <bckgd
	(13-19)	19	-		-
Polonium-210	(1.6-77)	3.8	13/15	5.3E-01 <bckgd	5.3E+00 11/15
	(2.5-34)	2.2	16/16		10/16
Radium-226	(1.5-17)	1.3	15/15	2.3E-01 <bckgd	2.3E+00 13/15
	(1.4-6.2)	1.3	16/16		10/16
Radium-228	(0.4-1.4)	1.69	-	7.9E-01 <bckgd	7.9E+00 -
	(1.0-1.5)	1.5	-		-
Thorium-228	(0.4-1.4)	1.6	-	7.4E-04 <bckgd	7.4E-03 <bckgd
	(1.0-2.3)	1.4	4/16		<bckgd
Thorium-230	(1.5-18)	14	2/15	5.7E+00 <bckgd	5.7E+01 -
	(1.5-18)	14	1/16		-
Thorium-232	(0.4-1.3)	1.7	-	6.4E+00 -	6.4E+01 -
	(0-4.6)	1.6	1/16	-	-
Uranium-Total	(1.3-16)	1.4	13/15	4.8E+00 8/15	4.8E+01 -
	(1.5-3.7)	1.2	16/16	-	-

Shading indicates exceedance of column value; shading in the analyte column indicates that the analyte has been retained as a constituent of concern following a risk-based screening.

NOTE: The risk-based value at a level of 10-6 for lead concentrations is less than background, but was exceeded in every case.

Iron has not been retained as a potential contaminant of concern, due to a lack of toxicological justification.

\* The risk-based cleanup standard for lead in residential soils, as per OSWER Directive #9355.4-02, September 1989

Table 5

## Revised Preliminary Screening for Potential Contaminants of Concern in Ground Water @ Monsanto

Values listed in units of mg/l, radionuclides listed in units of pCi/l

FRESH WATER, SHALLOW (as defined in Table 4-13 of the Preliminary Site Characterization report)

ANALYTE	Range of Site Concentrations	Maximum Background	MCL	MCLG	Human Health RfC (Residential Scenario)		Human Health WQC	#exceed. /#samples
					HI=0.1	HI=1		
Aluminum	(nondetect-0.278)	0.1	[0.05]SMCL	[0.05]	3.6E+00	-	3.6E+01	-
Arsenic	(nondetect-0.02)	0.005	0.05	[0.05]	1.1E-03	<bckgd	1.1E-02	(3/28)
Beryllium	(nondetect-0.002)	0.0025	0.004	0.004	1.8E-02	<bckgd	1.8E-01	-
Cadmium	(nondetect-8.0)	0.0025	0.005	0.005	1.8E-03	<bckgd	1.8E-02	(13/28)
Calcium	(44-375)	152	-	-	-	-	-	-
Chloride	(7-679)	7	250SMCL	-	-	-	-	-
Chromium	(nondetect-0.04)	0.005	0.1	0.1	1.8E-02	(2/28)	1.8E-01	-
Copper	(nondetect-0.009)	0.0125	[1]SMCL	1.3	1.4E-01	-	1.4E+00	-
Fluoride	(0.2-19.93)	0.3	2.0SMCL, 4	4	2.2E-01	<bckgd	2.2E+00	(9/22)
Iron	(nondetect-1.9)	0.3	-	-	-	-	-	-
Lead	(nondetect-0.006)	0.0025	0.05	0	-	-	-	-
Magnesium	(46.6-170)	45.1	-	-	-	-	-	-
Manganese	(nondetect-24.6)	0.0075	-	-	3.6E-01	(10/28)	3.6E+00	(1/28)
Molybdenum	(0.046-0.653)	not analyzed	-	-	1.5E-02	(5/5)	1.5E-01	(2/5)
Nickel	(nondetect-0.15)	0.02	0.1	0.1	7.3E-02	(5/28)	7.3E-01	-
Nitrate as N	(nondetect-35.2)	0.4	10	10	5.8E+00	(7/21)	5.8E+01	-
Potassium	(3.1-124)	2.5	-	-	-	-	-	-
Selenium	(nondetect-0.705)	0.0025	0.05	0.05	1.8E-02	(11/21)	1.8E-01	(5/21)
Silver	(nondetect)	0.005	-	-	1.8E-02	-	1.8E-01	-
Sulfate Ion	(30-680)	38.1	250SMCL	-	-	-	-	-
Vanadium	(nondetect-0.076)	0.01	-	-	2.6E-02	(1/28)	2.6E-01	-
Zinc	(ND-14.1)	0.01	[5]SMCL	-	7.3E-01	(6/28)	7.3E+00	(2/28)
RADIONUCLIDES					risk of 10-7		risk of 10-6	
Radium-226	(nondetect-1.3)	3.4	20	0	0.04	<bckgd	0.4	<bckgd
Radium-228	(nondetect)	3	20	0	0.05	<bckgd	0.5	<bckgd
Radon-222	(nondetect-680)	2200	300	0	1.1	<bckgd	1.1	<bckgd
Uranium (total)	(nondetect)	3	30	0	0.3	<bckgd	3	<bckgd

Radon has been retained as a constituent of concern, even though the background value is high. See text.

Parentheses in the MCL and MCLG columns indicate a proposed value.

Human Health Water Quality Criteria are based on drinking water alone. Source: USEPA 1986

Table 5 (continued)

## Revised Preliminary Screening for Potential Contaminants of Concern in Ground Water @ Monsanto

Values listed in units of mg/l, radionuclides listed in units of pCi/l

FRESH WATER, MEAD THRUST AQUIFER (as defined in Table 4-13 of the Preliminary Site Characterization report)

ANALYTE	Range of Site Concentrations	Maximum Background	MCL	MCLG	Human Health RfC (Residential Scenario)			Human Health WQC	#exceed. /#samples
					HI=0.1	HI=1			
Aluminum	(nondetect-2.9)	0.1	[0.05]SMCL	[0.05]	3.6E+00	-	3.6E+01	-	-
Arsenic	(nondetect-0.005)	0.005	0.05	[0.05]	1.1E-03	<bckgd	1.1E-02	1.8E-05	<bckgd
Beryllium	(nondetect)	0.0025	0.004	0.004	1.8E-02	<bckgd	1.8E-01	-	-
Cadmium	(nondetect)	0.0025	0.005	0.005	1.8E-03	<bckgd	1.8E-02	1.0E-02	-
Calcium	(117-224)	152	-	-	-	-	-	-	-
Chloride	(86-516)	7	250SMCL	-	-	-	-	2.5E+02	(1/5)
Chromium	(nondetect-0.04)	0.005	0.1	0.1	1.8E-02	(2/6)	1.8E-01	-	-
Copper	(nondetect)	0.0125	[1]SMCL	1.3	1.4E-01	-	1.4E+00	1.0E+00	-
Fluoride	(nondetect-0.51)	0.3	2.0SMCL, 4	4	2.2E-01	<bckgd	2.2E+00	-	-
Iron	(nondetect-2.2)	0.3	-	-	-	-	-	3.0E-01	(1/5)
Lead	(nondetect)	0.0025	0.05	0	-	-	-	5.0E-02	-
Magnesium	(43.3-83.3)	45.1	-	-	-	-	-	-	-
Manganese	(nondetect-0.181)	0.0075	-	-	3.6E-01	-	3.6E+00	5.0E-02	-
Molybdenum	0.425	not analyzed	-	-	1.5E-02	(1/1)	1.5E-01	(1/1)	-
Nickel	0.011	0.02	0.1	0.1	7.3E-02	-	7.3E-01	-	-
Nitrate as N	(5.45-8.6)	0.4	10	10	5.8E+00	(3/4)	5.8E+01	-	-
Potassium	(6.6-47.5)	2.5	-	-	-	-	-	-	-
Selenium	(nondetect)	0.0025	0.05	0.05	1.8E-02	-	1.8E-01	1.0E-02	-
Silver	(nondetect)	0.005	-	-	1.8E-02	-	1.8E-01	5.0E-02	-
Sulfate Ion	(66-1250)	38.1	250SMCL	-	-	-	-	2.5E+02	(2/4)
Vanadium	(nondetect-4.69)	0.01	-	-	2.6E-02	(4/6)	2.6E-01	(4/6)	-
Zinc	(nondetect-0.035)	0.01	[5]SMCL	-	7.3E-01	-	7.3E+00	5.0E+00	-
RADIONUCLIDES					risk of 10-7		risk of 10-6		
Radium-226	(nondetect)	3.4	20	0	0.04	<bckgd	0.4	<bckgd	
Radium-228	(nondetect)	3	20	0	0.05	<bckgd	0.5	<bckgd	
Radon-222	(nondetect-790)	2200	300	0	1.1	<bckgd	11	<bckgd	
Uranium (total)	(nondetect)	3	30	0	0.3	<bckgd	3	<bckgd	

Radon has been retained as a constituent of concern, even though the background value is high. See text.

Shading indicates exceedance of column values; shading in the analyte column indicates that the analyte has exceeded water quality standards or risk-based screening.

Reference values which are below maximum background values have been indicated.

Table 5 (continued)

## Revised Preliminary Screening for Potential Contaminants of Concern in Ground Water @ Monsanto

Values listed in units of mg/l, radionuclides listed in units of pCi/l

SODIC WATER, CHESTERFIELD RANGE (as defined in Table 4-13 of the Preliminary Site Characterization report)

ANALYTE	Range of Site Concentrations	Maximum Background	MCL	MCLG	Human Health RfC (Residential Scenario)		Human Health WQC	#exceed. /#samples
					HI=0.1	HI=1		
Aluminum	(nondetect-0.109)	nondetect	0.05SMCL	0.05	-	3.6E+01	-	-
Arsenic	(nondetect-0.007)	0.002	0.05	[0.05]	1.1E-03	<bckgd	1.1E-02	<bckgd
Beryllium	(nondetect)	nondetect	0.004	0.004	1.8E-02	<bckgd	1.8E-01	-
Cadmium	(nondetect-0.07)	nondetect	0.005	0.005	1.8E-03	<bckgd	1.8E-02	(2/12)
Calcium	(59.5-158)	203	-	-	-	-	2.5E+02	-
Chloride	(17-78)	23	250SMCL	-	-	-	-	-
Chromium	(nondetect-0.04)	nondetect	0.1	0.1	1.8E-02	(1/10)	1.8E-01	-
Copper	(nondetect)	nondetect	[1]SMCL	1.3	1.4E-01	-	1.4E+00	-
Fluoride	(0.15-2.04)	0.42	2.0SMCL, 4	4	2.2E-01	<bckgd	2.2E+00	-
Iron	(nondetect-16.8)	5.92	-	-	-	-	-	-
Lead	(nondetect-0.028)	nondetect	0.05	0	-	-	-	-
Magnesium	(69.8-275)	130	-	-	-	-	-	-
Manganese	(nondetect-0.64)	0.28	-	-	3.6E-01	(3/10)	3.6E+00	-
Molybdenum	0.037	not analyzed	-	-	1.8E-02	(1/1)	1.5E-01	-
Nickel	(nondetect-0.06)	nondetect	0.1	0.1	7.3E-02	-	7.3E-01	-
Nitrate as N	(nondetect-4.4)	4.25	10	10	5.8E+00	-	5.8E+01	-
Potassium	(5.6-28.2)	15	-	-	-	-	-	-
Selenium	(nondetect-0.075)	nondetect	0.05	0.05	1.8E-02	(1/10)	1.8E-01	-
Silver	(nondetect)	nondetect	-	-	1.8E-02	-	1.8E-01	-
Sulfate Ion	(54-270)	90	250SMCL	-	-	-	-	-
Vanadium	(nondetect-0.005)	nondetect	-	-	2.6E-02	-	2.6E-01	-
Zinc	(nondetect-0.44)	nondetect	[5]SMCL	-	7.3E-01	-	7.3E+00	-
RADIONUCLIDES					risk of 10-7	risk of 10-6		
Radium-226	(nondetect)	nondetect	20	0	0.04	<bckgd	0.4	<bckgd
Radium-228	(nondetect)	nondetect	20	0	0.05	<bckgd	0.5	<bckgd
Radon-222	(nondetect-540)	330	300	0	1.1	<bckgd	11	<bckgd
Uranium (total)	(nondetect)	nondetect	30	0	0.3	<bckgd	3	<bckgd

Shading indicates exceedance of standards; shading in the analyte column indicates that the analyte has exceeded water quality standards or risk-based screening. Reference values which are below maximum background values have been indicated.

Unfiltered sample data was used for wells TW-22, 30, 33, 40, 42 and 44.  
 Filtered sample data was used for wells TW-38, 43 and 50.

Split samples for wells TW-10, 12, 37, 36, 20, 22, Harris and Mormon were included in this analysis.

Table 6

## Revised Preliminary Data Screening for Potential Contaminants of Concern in On-site Source-Piles, Monsanto

Reference Concentrations are based on the worker scenario default exposure factors.

(Values are given in units of mg/kg.)

Analyte	Range of site Concentrations	Maximum Background	#exceed. /#samples	Noncancer RfCs (worker scenario)				Carcinogenic RfCs	
				HI=0.1	location**		HI=1	location	1E-06
Aluminum	(2780-27700)	16500	6/12	2.0E+05	-		2.0E+06	-	-
Arsenic	(3.3-500)	5.2	10/12	6.1E+01	6/12	D(1), U(3), P(2)	6.1E+02	-	3.3 12/12
Beryllium	(nondetect-6)	1	11/12	1.0E+03	-		1.0E+04	-	1.3 12/12
Cadmium	(3.8-1730)	9.7	11/12	1.0E+02	7/12	D(2), U(3), P(2)	1.0E+03	3/12 U(3)	-
Chromium VI	(27-1110)	16	12/12	1.0E+03	1/12	U(1)	1.0E+04	-	-
Copper	(8-86.9)	19.6	11/12	7.6E+03	-		7.6E+04	-	-
Fluoride	(36.4-349)	46.6	10/12	1.2E+04	-		1.2E+05	-	-
Iron	(2040-12200)	19200	-	-	-		-	-	-
Lead	(4.4-200)	39	6/12	500*	-		-	-	-
Manganese	(42-222)	696	-	2.0E+04	-		2.0E+05	-	-
Nickel	(15-170)	43	10/12	4.1E+03	-		4.1E+04	-	-
Nitrate as N	(nondetect-79)	13	3/12	3.3E+05	-		3.3E+06	-	-
Selenium	(nondetect-1.7)	0.8	2/12	1.0E+03	-		1.0E+04	-	-
Silver	(1-29)	1	11/12	1.0E+03	-		1.0E+04	-	-
Vanadium	(37-1810)	42	11/12	1.4E+03	4/12	U(3), P(1)	1.4E+04	-	-
Zinc	(5.1-10900)	123	10/12	4.1E+04	-		4.1E+05	-	-

Reference values which are below the detection limit have been indicated.

Shading indicates exceedance of column value; shading in the analyte column indicates that the analyte has been retained as a constituent of concern following a risk-based screening.

Iron has not been retained as a potential contaminant of concern, due to a lack of toxicological justification.

\* The risk-based cleanup standard for lead in residential soils, as per OSWER Directive #9355.4-02, September 1989

Table 6 (continued)  
Revised Preliminary Data Screening for Potential Contaminants of Concern in On-Site Source Piles, Monsanto

(Values are given in units of pCi/g)

Analyte	Range of Site Concentrations	Maximum Background	#exceed. /#samples	Radionuclide RfCs (worker senario) locations**			Risk of 10-6	location
Lead-210	(1.2-260)	3	10/12	6.2E-01	<bckg	all	6.2E+00	10/12 all
Polonium-210*	(nondetect-260)	3.8	10/12	2.1E+00	<bckg	all	2.1E+01	8/12 D(2), U(3), P(3)
Potassium-40	(1.6-11)	20	-	9.3E-03	<bckgd		9.3E-02	<bckgd
Radium-226	(1.2-54)	1.3	11/12	3.6E-01	<bckg	all	3.6E+00	11/12 all
Radium-228	(0-1.0)	1.69	-	3.2E+00	-		3.2E+01	-
Thorium-228	(nondetect-5.1)	1.6	1/12	8.9E-04	<bckg ]		8.9E-03	<bckg all
Thorium-230	(nondetect-430)	14	9/12	2.0E+01	8/12 S(3), D(2), U(3)		2.0E+02	S(1)
Thorium-232	(0.1-4.8)	1.7	2/12	2.4E+01	-		2.4E+02	-
Uranium-Total	(1.3-47)	1.4	11/12	1.9E+01	8/12 S(3), D(2), U(3)		1.9E+02	-

Shading indicates exceedence of column value; shading in the analyte column indicates that the analyte has been retained as a constituent of concern following a risk-based screening.

NOTE: The risk-based value at a level of 10-6 for lead concentrations is less than background, but was exceeded in every case. Location abbreviations are as follows; Slag Pile (S), Baghouse Dust (D), Underflow Solids (U), and Slurry Ponds (P)

Table 7  
Preliminary Data Screening for Potential Contaminants of Concern in Off-site Sediments, Monsanto

(Values are given in units of mg/kg.)

Analyte	Range of site Concentrations	Maximum Background	#exceed. /#samples	Noncancer RfCs		Carcinogenic RfCs	
				HI=0.1	HI=1	1E-06	
Aluminum (0-1")	(3300-8780)	16500	-	2.7E+04	2.7E+05	-	-
Arsenic	(4.6-15)	5.2	5/6	8.2E+00	8.2E+01	-	0.37 <det.lim
Beryllium	(2-4)	1	6/6	1.4E+02	1.4E+03	-	0.15 <det.lim
Cadmium	(8.3-29.6)	9.7	5/6	1.4E+01	1.4E+02	-	-
Chromium VI	(4-19)	16	2/6	1.4E+02	1.4E+03	-	-
Copper	(nondetect-22)	19.6	1/6	1.1E+03	1.1E+04	-	-
Fluoride	(1.7-4.9)	46.6	-	1.6E+03	1.6E+04	-	-
Iron	(95800-197000)	19200	6/6	-	-	-	-
Lead	(1.8-11)	39	-	500*	-	-	-
Manganese	(481-1270)	696	4/6	2.7E+03	2.7E+04	-	-
Nickel	(52-153)	43	6/6	5.5E+02	5.5E+03	-	-
Nitrate as N	not analyzed	13	-	4.4E+04	4.4E+05	-	-
Selenium	(nondetect-1.2)	0.8	2/6	1.4E+02	1.4E+03	-	-
Silver	(0.1-0.5)	1	-	1.4E+02	1.4E+03	-	-
Vanadium	(17-208)	42	3/6	1.9E+02	1.9E+03	-	-
Zinc	(27-170)	123	1/6	5.5E+03	5.5E+04	-	-

Reference values which are below the detection limit have been indicated.

Shading indicates exceedance of column value; shading in the analyte column indicates that the analyte has been retained as a constituent of concern following a risk-based screening.

Table 7 (continued)  
Preliminary Data Screening for Potential Contaminants of Concern in Off-site Sediments, Monsanto

(Values are given in units of pCi/g)

Analyte	Range of Site Concentrations	Maximum Background	#exceed. /#samples	Radionuclide RfCs		
				Risk of 10-7	Risk of 10-6	
Lead-210	(0-1.8)	3	-	1.5E-01 <bckgd	1.5E+00	15/15
K-40	(3.3-8.3)	20	-	7.0E+00 <bckgd	7.0E+01	-
Polonium-210*	(0.5-3.3)	3.8	-	5.1E-01 <bckgd	5.1E+00	11/15
Radium-226	(0.5-0.8)	1.3	-	6.4E-01 <bckgd	6.4E+00	6/15
Radium-228	(0.3-2.3)	1.69	1/6	7.7E-01 2/6	7.7E+00	-
Thorium-228	(0.3-0.6)	1.6	-	1.4E+00 <bckgd	1.4E+01	-
Thorium-230	(0.4-1.4)	14	-	5.9E+00 -	5.9E+01	-
Thorium-232	(0.1-0.4)	1.7	-	6.4E+00 -	6.4E+01	-
Uranium-Total	(nondetect-0.6)	1.4	-	2.7E+00 -	2.7E+01	-

Shading indicates exceedance of column value; shading in the analyte column indicates that the analyte has been retained as a constituent of concern following a risk-based screening.

NOTE; The risk-based value at a level of 10-6 for lead concentrations is less than background, but was exceeded in every case.

Iron has not been retained as a potential contaminant of concern, due to a lack of toxicological justification.

\* The risk-based cleanup standard for lead in residential soils, as per OSWER Directive #9355.4-02, September 1989